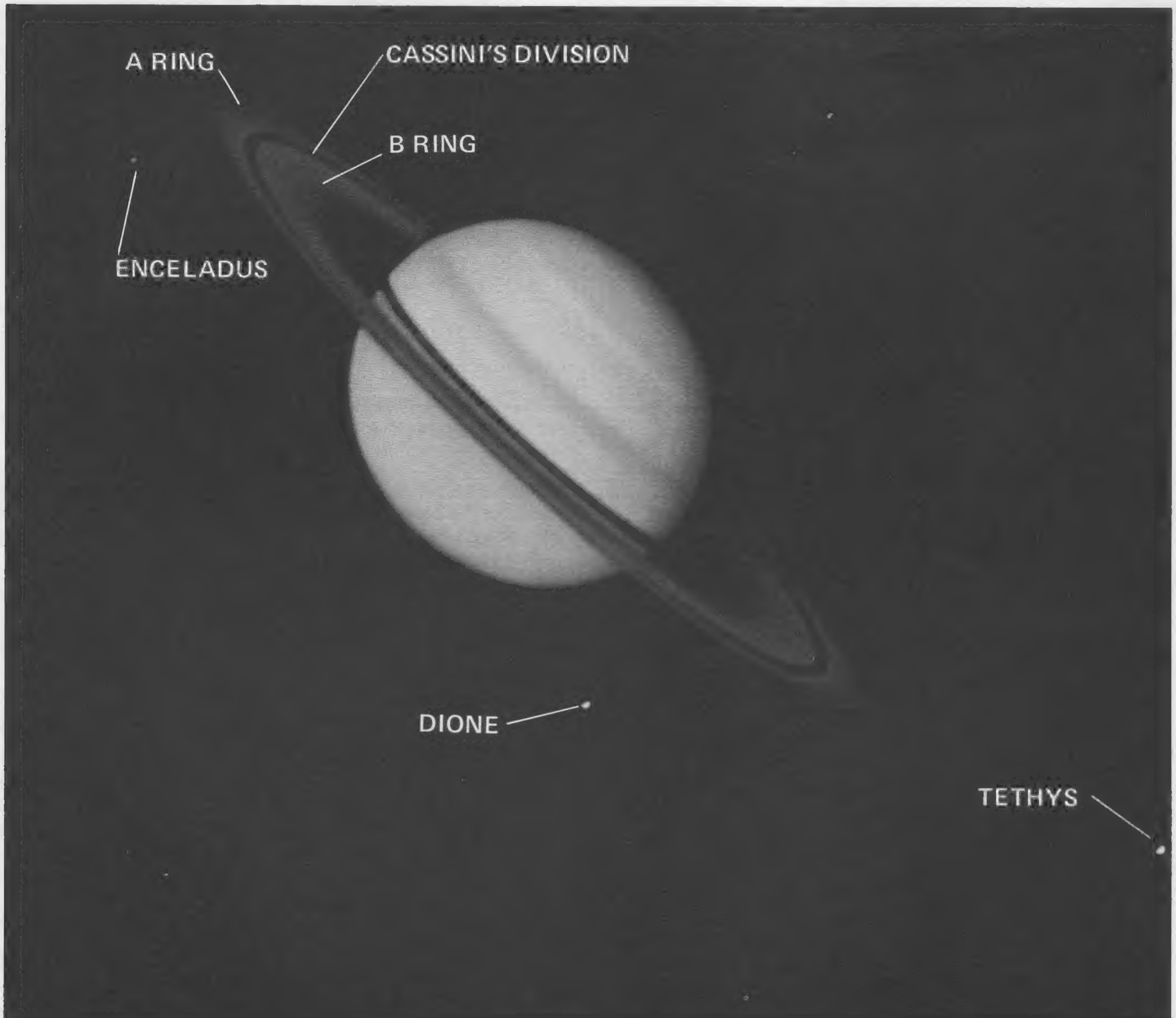
Voyager Bulletin

MISSION STATUS REPORT NO 52 AUGUST 27, 1980



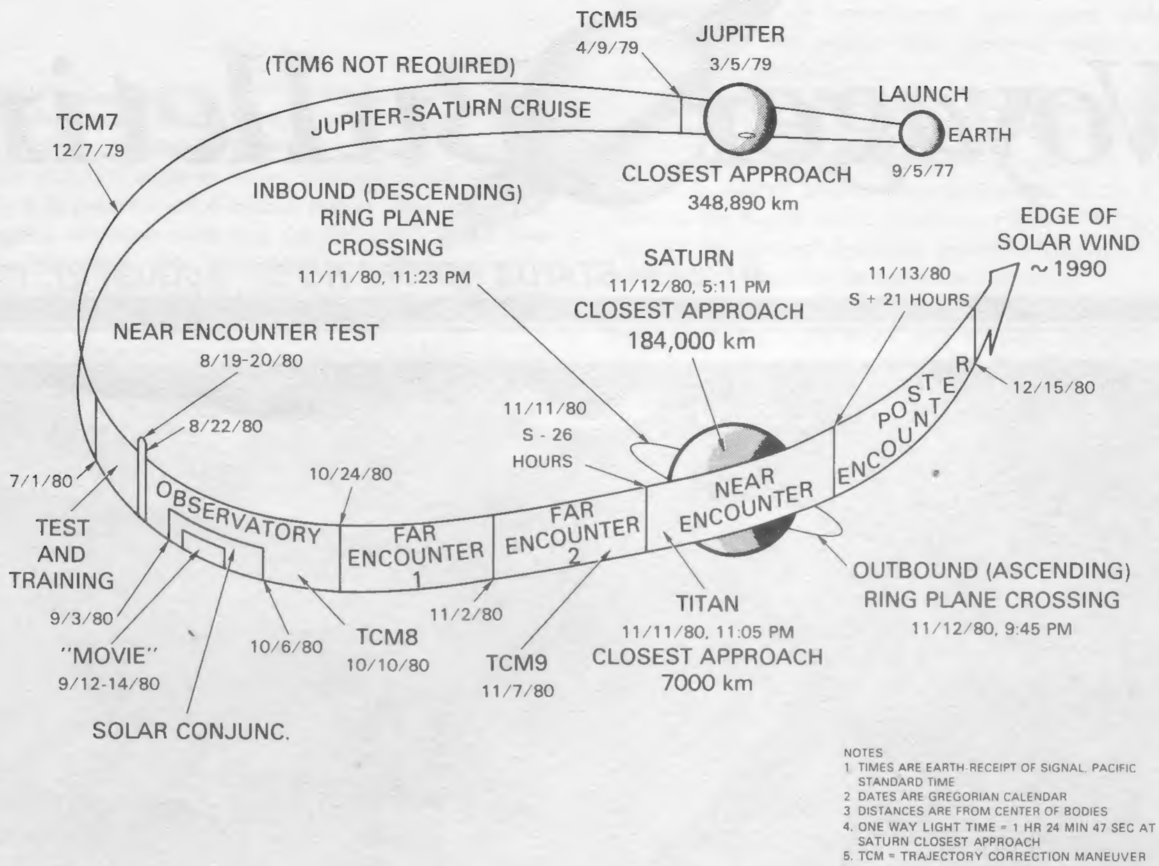
OBSERVE: SATURN — Voyager 1's encounter with the planet Saturn has begun with a series of photos, among them this one of Saturn and three of its satellites. The picture was taken August 24, 80 days before closest approach, when Voyager 1 was 106,250,000 kilometers (66 million miles) away. A series of dark and light cloud bands appears through high-altitude atmospheric haze in the northern hemisphere. Considerable structure can be seen in the rings: Cassini's Division, between the A-ring and B-ring, is readily visible. The shadow of the rings on the planet's disk can also be seen.

NASA

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Recorded Mission Status (213) 354-7237
Status Bulletin Editor (213) 354-4438
Public Information Office (213) 354-5011



Saturn Encounter Phases

The Saturn Encounter activities have been divided into five phases, arbitrarily chosen based on the field of view of the narrow angle camera in relation to the distance to the planet. The five phases are Observatory, Far Encounter 1, Far Encounter 2, Near Encounter, and Post Encounter.

Observatory starts August 22, about 82 days before closest approach, and runs nine weeks. During this period, a long time base history of the Saturn system will be compiled.

Daily ultraviolet scans of the system will search for hydrogen sources. The fields and particles instruments will monitor the interplanetary medium near Saturn.

Two time-lapse movies will be compiled from photographs taken during this period. Color "zoom" movies will be compiled from photographs taken every 2 hours 3.2 minutes over about two months. These movies will focus on five longitudes as the spacecraft "zooms" in on the planet. A second color movie will be compiled from photographs taken every 4.8 minutes during a 42-hour period September 12-14, covering four Saturn rotations.

Radio experiments to study the sun's corona will be performed during solar conjunction, when the sun will be between the Earth and spacecraft. From September 3 through October 6, the angle defined by Voyager, the earth, and the sun, will be 15 degrees or less, hampering radio communications, but allowing study of the sun as the radio signals pass through its corona.

A trajectory correction maneuver to adjust the flight path will be done on October 10. Numerous other calibrations will also be done during the Observatory phase.

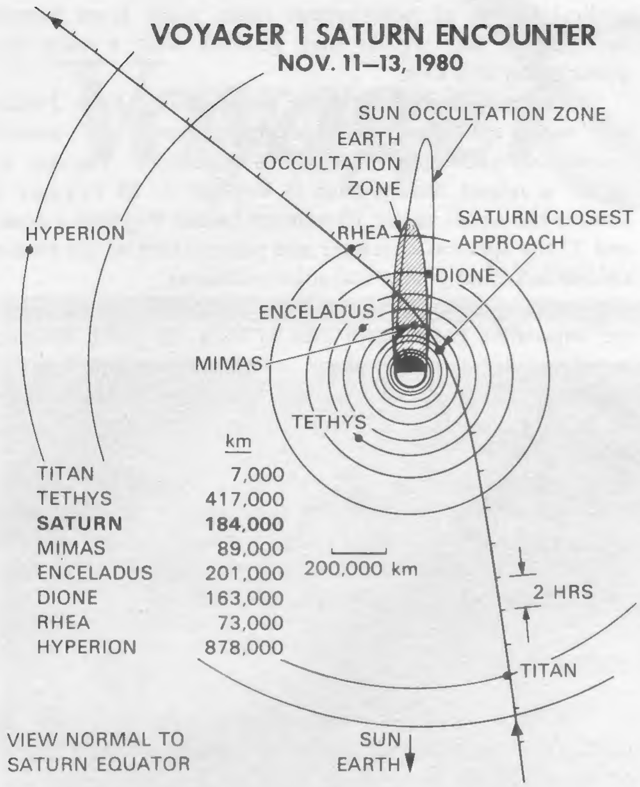
By October 24, 19 days before closest approach, the narrow angle camera's field of view will no longer capture the entire planet in one frame. Two by two mosaics (four pictures to cover the entire planet) will signal the start of the next phase, **Far Encounter 1**. Voyager 1 will be 16 million miles from the ringed planet.

Within another ten days, the **Far Encounter 2** phase will begin when 2x2 mosaics no longer suffice to cover the entire planet. On November 2, Voyager 1 will be 8.8 million miles from Saturn. The final Voyager 1 trajectory correction maneuver is scheduled for November 7.

The 47-hour **Near Encounter** phase begins November 11, 26 hours before Saturn closest approach, and runs through November 13, 21 hours after closest approach. At approximately 11:05 p.m. PST on November 11, signals from Voyager 1's closest approach (7000 km) to Titan will arrive at Earth. Eighteen minutes later, the spacecraft will dip below the ring plane. Eighteen hours after Titan closest approach, Voyager 1 will make its closest approach to Saturn on November 12. It will be below the rings, 184,000 km from the shadowed southern hemisphere. The signal will reach Earth about 5:11 p.m. Four and a half hours later, Voyager 1 will make its outbound, ascending ring plane crossing.

Voyager 1's observations of Saturn will continue in the **Post Encounter** phase through December 15. It will then continue to observe the interplanetary medium for as long as we can track the spacecraft, participating in celestial mechanics and solar experiments with other interplanetary spacecraft still being tracked.

If Voyager 1 is still being tracked ten years hence, we may observe the edge of the influence of the sun's magnetic field, some 20 to 30 times farther from the sun than Earth is. Voyager 1 will be on a solar system escape trajectory that will take it out of the ecliptic plane – that plane in which most of the solar system's bodies lie.

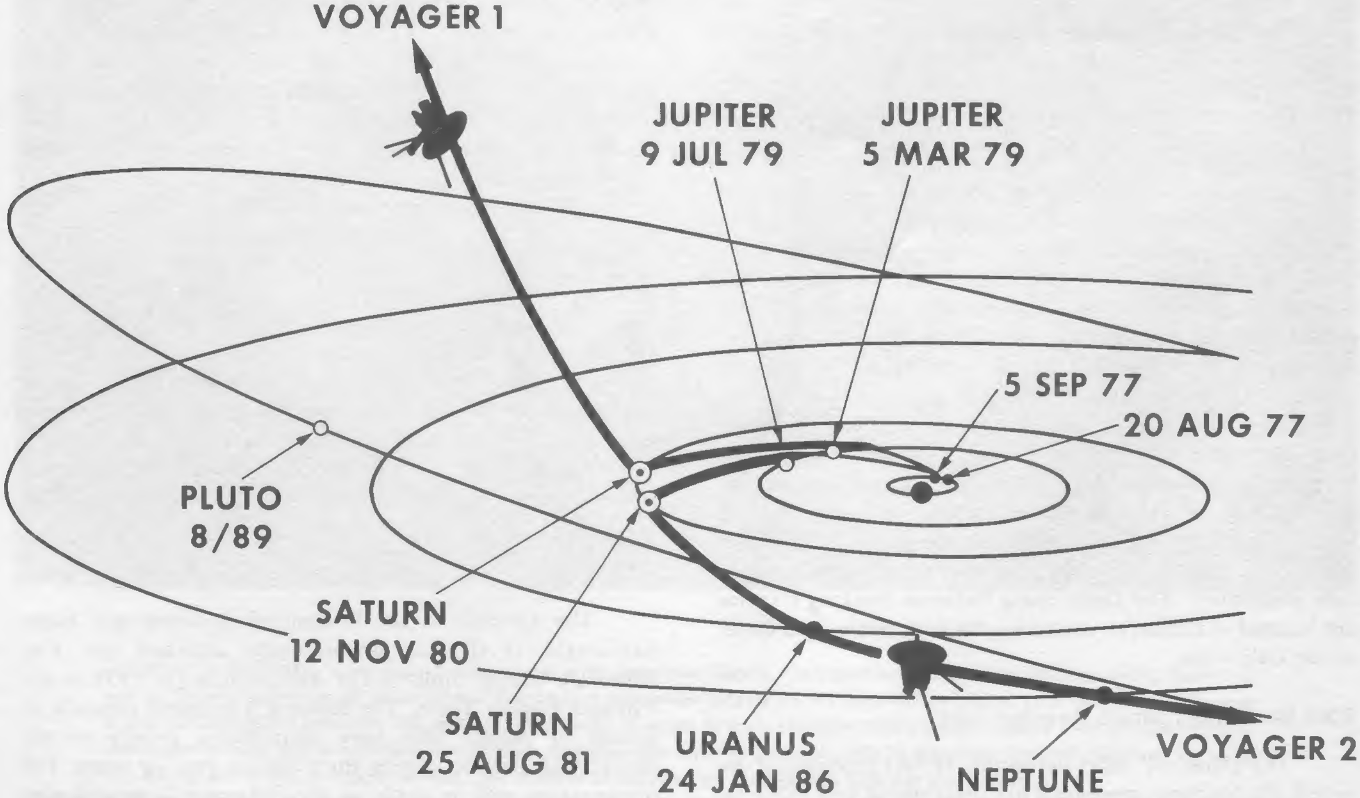


Note: Distances are approximate closest approach measured from center of body. Saturn closest approach will be about 184,000 km from the center of the planet, or 124,000 km from the cloudtops, using a Saturn radius of 60,000 km.

Test and Training

The Voyager Flight Team has been certified ready for Saturn Encounter operations after a seven-week test and training period. A key part of test and training was simulations of Murphy's Law No. 1: "Whatever can go wrong, will go wrong, at the worst possible time." Some of the simulated problems included fire in the mission control area during planned commanding, requiring relocation of operations to another building; incorrect real-time command requests; ground-based computer failure during satellite pointing updates and optical navigation; apparent propulsion hardware failure during a simulated trajectory correction maneuver; bad data from an instrument; and spacecraft computer failures. A prime objective of the test and training period has been to sharpen all skills so that nothing is done by rote.

Test and training climaxed August 18-19 with the Near Encounter Test, a simulation of 18 hours of the period of closest approach to Saturn. A near-duplicate of the near encounter computer sequence was sent to Voyager 1 and activated. Alternate pointing commands were issued to the scan platform to avoid pointing the cameras directly at the sun during the test. At Saturn, the planet will block the sun's light during these sequences, giving occultation data. The spacecraft will be oriented by its inertial gyro system during the near encounter phase, as there will be several spacecraft maneuvers about the roll, pitch, and yaw axes.



MISSION PLAN – After its flyby of the Saturn system in November, Voyager 1 will be on an escape trajectory from the solar system which will carry it above the ecliptic plane. Voyager 2 will reach Saturn in August 1981 and then has the opportunity to continue to encounters with the planets Uranus and Neptune. Neither ship will come close to the solar system's ninth planet, Pluto, in its 248-year trip around the sun.

Update

Voyager 1

Voyager 1 began its concentrated observations of Saturn on August 22, 82 days before its closest approach to the ringed planet. Travelling with a heliocentric velocity of 20.4 km/s (45,675 miles an hour), the spacecraft is about 109 million kilometers (67.6 million miles) from the planet. Radio signals between earth and the spacecraft travel over 1.4 billion kilometers (901 million miles) in 80 minutes.

The spacecraft has experienced minor hardware problems in the Canopus star tracker and the scan platform, but neither is expected to pose a serious problem to the planned Saturn encounter activities.

Voyager 1's Canopus star tracker has a problem which limits its available fields of view. Investigation into the problem shows that all required stars can be tracked, with the possible exception of the star Vega which is required after Saturn closest approach. The back-up star tracker has been tested and could be used if needed after appropriate calibrations are completed.

The Canopus star tracker helps stabilize the spacecraft and keep it properly oriented by tracking the earth, sun, and a reference star (nominally Canopus).

In addition, Voyager 1's scan platform has experienced a "creep" of 0.17 degrees for negative slews in the elevation axis. The creep seems to occur over a one to four hour period, when it occurs. Several solutions which will eliminate any concern from this problem are under consideration.

Voyager 2

Voyager 2 continues in interplanetary cruise. Its operations during its sister craft's Saturn activities will be limited to routine calibrations and navigation.

DSN Completes Station Updates

All three Deep Space Network stations now boast one each 26-, 34-, and 64-meter antennas. One 26-meter antenna at each station has been enlarged to 34 meters. The enlargement greatly expands the tracking capabilities of the network, as the distances to the spacecraft increase and the number of spacecraft being tracked also grows. By electrically combining the signals received by a 34- and a 64-meter antenna (a technique known as arraying), a 28 percent increase in received signal strength is realized over that achievable with a 64-meter station alone. Even with this improvement, the highest data rate achievable from Voyager at Saturn will be 44.8 kilobits per second, in contrast to the 115.2 kilobits per second received from Jupiter. Without arraying, the maximum rate would be 29.9 kilobits per second. The extreme distance involved lowers the data rate availability. The Deep Space Network tracking stations are located at Canberra, Australia; Madrid, Spain; and Goldstone, California.

PRA Determines Saturn Rotation Rate

The planetary radio astronomy (PRA) experiment onboard the Voyager spacecraft has determined Saturn's rotation rate to be 10 hours 39.4 minutes (± 0.15 minutes) for the bulk of Saturn. Earth observations had shown similar periods for temperate and polar regions of Saturn, but a much shorter (10 hours 14 minutes) period near the equator, indicating the presence of a high-velocity equatorial jet stream.

Correlation of data taken by both spacecraft shows cyclical bursts of non-thermal radio noise from Saturn occurring at this regular time interval, with a noise frequency near 200 kHz.

The emissions have been distinguished from Jovian and solar emissions and background noise by several criteria: 1) the signal intensity is higher for Voyager 1, which is nearer Saturn than is Voyager 2; 2) Voyager 1 detects the signal about 10 minutes before Voyager 2 does; and 3) the spectral character and polarization of the events are distinct from Jovian and solar emissions.

Such precise measurements of Saturn's rotation rate are impossible from Earth due to both the great distance (nearly a billion miles) and the fact that Saturn's peak radio emissions fall in a radio communications band used on earth. Pioneers 10 and 11 did not carry this type of instrumentation.

Saturn has been thought to have a regular magnetic field and little offset between the magnetic pole and spin axis (Earth's offset is 23.5°), but the ability to determine a rotation rate for Saturn implies a deviation from perfect axial symmetry of the planetary magnetic field.

1979J3 Makes 16

A new small satellite orbiting near the edge of Jupiter's wafer-thin ring brings to sixteen the number of confirmed Jovian satellites.

The new satellite, 1979J3, orbits about 56,200 kilometers above the cloudtops with a period of 7 hours 4.5 minutes and a velocity of 31.5 km/s. Its diameter is about 40 kilometers.

Discovered by JPL optical navigation engineer Steve Synnott, 1979J3 was assumed to be 1979J1 when found during a search to confirm the orbit of that satellite last March. 1979J1, discovered last fall in photos taken by Voyager 2 in July 1979, has similar characteristics with a diameter of 30 to 40 kilometers, a period of 7 hours 8 to 10 minutes, and an orbit at the outer edge of the ring some 57,800 kilometers above the cloudtops.

This spring, when checking Voyager 1 pictures from March 1979 to verify 1979J1, Synnott discovered 1979J2, another small satellite 70 to 80 kilometers in diameter orbiting between Amalthea and Io. At that time he also sighted an object thought to be 1979J1. However, further crosschecking between Voyager 1 and 2 photos showed that this object would have been on the opposite side of Jupiter from 1979J1's position when Voyager 2 photographed it. This led to the discovery of 1979J3.

Many scientists feel that such small satellites may influence the composition and stability of planetary rings.

Awards

The Council of the Federation Aeronautique Internationale (FAI) has unanimously awarded the FAI Honorary Group Diploma for Astronautics for 1979 to the Voyager Project Team. The diploma is awarded annually to groups of people who have contributed greatly to the progress of aviation during the previous year or years. The presentation will be made at the federation's general conference in Auckland, New Zealand November 8-12, 1980.

Raymond L. Heacock, Voyager project manager at JPL, has accepted the James Watt International Medal awarded by the Institution of Mechanical Engineers in England. The presentation was made June 25, 1980 at the institute's London headquarters.